

# Chapter 5. Base and Future System Performance

Performance of the state transportation system was quantified using the factors and measures described in Section 4.0. These measures establish the existing (year 2002) and future 2025 “base-line” conditions on state roadways. This analysis was conducted prior to evaluation and analysis of specific project bundles for the MoveAZ Plan evaluation process.

Both existing (2002) projects and financially committed projects (specified by ADOT) to be constructed by 2025 were considered. As shown in Table 5.1, several of the roadway performance measures were not applied to identify base and future performance. Some were omitted because of a lack of data; others because they were useful for comparative purposes only; and still others because they focused on the programming process, rather than project analysis.

**Table 5.1 Measures Not Used in System Performance Analysis**

Performance Measure	No System Performance Calculations		Reasons for Not Including These Measures in Systems Analysis
	2002	2025	
Reconstruction need	●	●	Relevant only for project comparison (interim measure)
Pavement condition		●	Separate programming area
VMT by pavement condition		●	Separate programming area
Bridge condition	●	●	Separate programming area
Vehicle trips by bridge condition	●	●	Separate programming area
Park-and-ride spaces	●	●	Data unavailable
Bus turnouts	●	●	Data unavailable
Percentage of air quality improvement projects selected	●	●	Relevant only for project comparison
Noise exposure	●	●	Data unavailable
Projects listed in RTPs	●	●	Relevant only for project comparison

Results of the existing and future year system performance analysis are presented below by factor for the state highway system only. This analysis was used as a benchmark for evaluating the performance benefits of each project bundle analyzed in the MoveAZ Plan evaluation process, as presented in Chapter 4.

## ■ 5.1 Mobility and Economic Competitiveness

### Percent of Person-Miles of Travel by Level of Service

This measure considers the percentage of PMT that occur at acceptable levels of congestion. Congestion is measured on the highway system using a LOS grading system. Roadway segments with LOS A have substantial excess capacity. Segments with LOS F are gridlocked. ADOT has defined acceptable congestion in Arizona as LOS C or better in rural areas, and LOS D or better in urban areas. As shown in Table 5.2, this measure predicts that, statewide, Arizonans will be half as likely to find acceptable congestion levels on state routes in 2025 as in 2002. PMT under congested conditions are projected to nearly double in the Tucson district and to more than double in the Safford, Phoenix, and Prescott districts. In the Yuma, Holbrook, Kingman, and Flagstaff districts, which currently experience a very low percentage of total PMT at unacceptable congestion levels, the proportion of travel in unacceptable congested conditions is projected to increase by tenfold or more.

**Table 5.2 Percent of PMT by LOS and District**

District	% PMT at LOS A-C Rural, LOS A-D Urban	
	2002	2025
Flagstaff	97	54
Globe	84	79
Holbrook	100	82
Kingman	98	59
Phoenix	64	20
Prescott	73	40
Safford	93	68
Tucson	68	38
Yuma	100	39
<b>State Total</b>	<b>77</b>	<b>38</b>

Source: Cambridge Systematics, Inc., October 2003.

## Average Delay Per Trip

As shown in Table 5.3, motorists will see the length of their average delay rise six fold between 2002 and 2025, from about one minute to seven minutes per trip. While the Phoenix district contributes significantly to the overall increase in roadway delay, other urban and rural districts also are expected to show significant increases in average delay. For example, the residents of the Yuma, Prescott, and Kingman districts will experience trip delays of about two additional minutes per motor vehicle trip.

**Table 5.3 Average Delay Per Vehicle Trip by District**

District	Average Delay Per Trip (Hours:Minutes)	
	2002	2025
Flagstaff	0:56	1:40
Globe	0:44	1:34
Holbrook	0:15	0:27
Kingman	0:35	2:39
Phoenix	1:56	9:16
Prescott	0:43	2:29
Safford	0:27	1:08
Tucson	0:37	3:16
Yuma	0:54	2:49
<b>State Total</b>	<b>1:17</b>	<b>6:58</b>

Source: Cambridge Systematics, Inc., October 2003.

## ■ 5.2 Connectivity

### Ability to Overtake in Major Two-Lane Corridors

The ability to pass is measured as the ratio of the existing or projected traffic volume (AADT) to the passing service volume. The passing service volume is calculated as a function of terrain, curves, percent of vehicles that are heavy trucks, and other factors. A value of 1.0 represents a traffic volume that is equal to the passing service volume. In most cases, it should be possible to pass other vehicles in a reasonable amount of time at this level. A value of 1.5 indicates that there are 50 percent more vehicles than in the acceptable passing situation.

As shown in Table 5.4, most two-lane state roadways are currently operating at acceptable levels of passing ability, without substantial need for additional passing lanes. However, the analysis predicts that, by 2025, most districts across the State will be approaching values at which passing on a two-lane segment becomes undesirably difficult. The state average passing ability measure will be 1.23 by 2025, indicating that almost 25 percent more vehicles are using roadways than can be accommodated with easy passing. Though all districts across Arizona will suffer, rural areas in districts such as Prescott, Globe, and Flagstaff will be particularly impacted relative to existing conditions.

**Table 5.4 Passing Ability by District (Ratio of AADT to Passing Service Volume)**

District	2002	2025
Flagstaff	1.01	1.51
Globe	1.23	1.51
Holbrook	0.59	0.74
Kingman	1.06	1.25
Phoenix	0.39	1.11
Prescott	1.26	1.81
Safford	0.63	0.88
Tucson	0.64	1.35
Yuma	0.38	0.87
<b>State Total</b>	<b>0.82</b>	<b>1.23</b>

Source: Cambridge Systematics, Inc., October 2003.

## Intercity Travel Time Connectivity

As shown in Table 5.5, driving time in important travel corridors across Arizona is expected to increase an average of 32 percent between 2002 and 2025. Driving times in the Phoenix to Hoover Dam, Phoenix to Lukeville, Phoenix to Mogollon Rim, and Prescott to Cordes Junction corridors will increase even more; an indication that traffic volumes in these corridors will reach or exceed roadway capacities. For example, travel time is projected to increase 68 percent in the Prescott to Cordes Junction corridor, and 82 percent in the Phoenix to Hoover Dam corridor.

**Table 5.5 Intercity Travel Time by Corridor**

<b>Corridor</b>	<b>2002</b>	<b>2025</b>
Douglas – Benson	2:10	2:30
Phoenix – Hoover Dam (Nevada State Line)	4:50	8:00
Flagstaff – Page (Utah State Line)	2:30	2:30
Phoenix – Globe	1:00	1:00
Phoenix – Lukeville	2:30	4:40
Phoenix – Mogollon Rim (Show Low)	3:20	4:50
Prescott – Cordes Junction	0:50	1:20
Yuma – Bullhead City	3:50	4:00
Tucson – Holbrook	4:30	4:50

Source: Cambridge Systematics, Inc., October 2003.

## ■ 5.3 Preservation

ADOT uses pavement and bridge management systems to evaluate pavement and bridge conditions and identify projects to maintain these conditions at levels established by the Transportation Board. These management systems provide a very detailed form of performance measurement for particular types of projects. Because the MoveAZ plan only evaluates major capital projects, most of the pavement and bridge measures are not calculated here. The only measure used by MoveAZ in the project evaluation is the “reconstruction need” measure. Currently, however, reconstruction need was used to support the project bundle evaluations only, not to assess base and future roadway performance. Base and future year performance for the reconstruction need measure is not relevant at an aggregate district level, but is relevant at the project level.

## ■ 5.4 Reliability

Unexpected delay that does not recur on a daily basis at predictable times and locations is a major detriment to reliability and predictability. Additional unexpected motorist delay, caused by events such as crashes and other more or less random events, is expected to nearly quadruple between 2002 and 2025, from less than one hour per 1,000 VMT to over three hours per 1,000 VMT (Table 5.6). This equates to almost 450,000 hours of unexpected delay per day in 2025.

**Table 5.6 Unexpected Delay by District (Hours Per 1,000 VMT)**

<b>District</b>	<b>2002</b>	<b>2025</b>
Flagstaff	0.62	0.53
Globe	0.06	0.06
Holbrook	0.04	0.20
Kingman	0.07	2.15
Phoenix	2.01	6.07
Prescott	0.20	1.25
Safford	0.07	0.22
Tucson	0.46	2.55
Yuma	0.12	2.57
<b>State Total</b>	<b>0.81</b>	<b>3.19</b>

Source: Cambridge Systematics, Inc., October 2003.

In the Globe district, unexpected delay is not projected to increase; and in the Flagstaff district, it is expected to decline slightly. In all other Arizona districts, however, unexpected delay will increase significantly over the next two decades. The Yuma and Kingman districts are projected to have the most significant percent increase in unexpected delays, which will rise by about 15 minutes and 10 minutes per 1,000 VMT, respectively. The Tucson, Prescott, and Holbrook districts will all see five-fold increases in unexpected delay. In the Phoenix district, unexpected delays are projected to increase at a somewhat slower pace, but Phoenix's overall level of unexpected delay – about two hours in 2002 and about six hours in 2025 per 1,000 VMT – is by far the highest in the State.

## ■ 5.5 Safety

### **Crashes Per 100 Million VMT**

Crash rates distinguish between those involving injuries, fatalities, or only property damage. Crash rates in Arizona are projected to change over time as a result of factors such as changing average vehicle speeds, or improvements to the highway facilities (e.g., improved from two-lane undivided to a four-lane divided highway.) As shown in Table 5.7, the number of motor vehicle crashes involving injuries per 100 million VMT is projected to decrease slightly between 2002 and 2025, statewide. Some individual districts' crash and injury rates will increase, while others will decrease. However, every

district's fatality rate is expected to stay the same or increase slightly by 2025. Crash and injury rates in the Kingman and Prescott districts are projected to increase by over 10 percent, the most significant increase of any district. In contrast, crash and injury rates in the Yuma district are projected to decline by almost 20 percent, though the fatality rate is still expected to increase by 10 percent.

In the Holbrook district, overall crash rates are relatively low, but fatality rates are the highest in Arizona; three in every 100 crashes involving motor vehicles in Holbrook involve a fatality, a number that is not projected to change by 2025. Both the Tucson and Phoenix districts have the lowest number of fatalities as a percent of total crashes, with less than one fatality-related crash per 200 crashes involving motor vehicles in both 2002 and 2025. In the Yuma district, nearly 30 of every 100 crashes involve an injury, the highest number of injuries as a percent of total crashes for both 2002 and 2025. In the Flagstaff district, however, only 21 of every 100 crashes involve an injury.

**Table 5.7 Crashes Per 100 Million VMT by District**

District	2002			2025		
	Crash	Injury	Fatality	Crash	Injury	Fatality
Flagstaff	165.0	44.5	1.9	172.9	46.8	2.1
Globe	151.6	54.6	3.2	148.1	60.7	3.5
Holbrook	56.0	20.0	2.4	59.3	19.4	2.4
Kingman	132.4	45.9	2.3	149.5	51.7	2.3
Phoenix	761.6	287.3	3.5	776.9	292.7	3.6
Prescott	154.3	51.7	2.2	171.0	58.3	2.3
Safford	132.9	43.5	2.3	137.0	47.0	2.4
Tucson	472.5	184.2	3.1	469.2	183.2	3.2
Yuma	132.6	55.1	3.0	106.2	46.1	3.3
<b>State Total</b>	<b>421.0</b>	<b>157.1</b>	<b>2.9</b>	<b>415.7</b>	<b>155.8</b>	<b>3.1</b>

Source: Cambridge Systematics, Inc., October 2003.

### Anticipated Change in Injuries/Fatalities

Even in cases where injury rates remain constant or decrease between 2002 and 2025, the total *number* of annual injuries and fatalities is projected to increase due to the overall rise in VMT. This trend is shown in Table 5.8. In percentage terms, most districts will see the number of motor vehicle-related injuries and fatalities double. The Yuma and Prescott districts will see the largest increases in percentage terms: 228 percent and 138 percent, respectively, for injuries; and 333 percent and 121 percent, respectively, for fatalities. In absolute terms, the Phoenix district will see the largest increase in injuries and fatalities,

with 26,000 additional annual motor vehicle-related injuries and 330 additional annual motor vehicle-related fatalities projected to occur there in 2025. The Phoenix and Tucson districts have – and will continue to have in 2025 – the highest VMT in the State and the highest numbers of annual injuries and fatalities related to motor vehicles. Currently, the Flagstaff district has the third highest number of annual injuries (almost 1,000) in 2002, but will be surpassed by the Yuma district by 2025 as a result of the latter’s projected three-fold increase in injuries. The Globe district has the fewest number of fatalities and the Holbrook district has the fewest injuries, both now and in the future.

**Table 5.8 Anticipated Change in Injuries/Fatalities by District**

District	2002-2025 Change in Injuries		2002-2025 Change in Fatalities	
	Absolute Change	Percent Change	Absolute Change	Percent Change
Flagstaff	911	94%	40	95%
Globe	404	83%	23	81%
Holbrook	230	80%	30	89%
Kingman	1,039	139%	41	108%
Phoenix	26,367	107%	330	110%
Prescott	1,262	138%	48	121%
Safford	617	103%	31	99%
Tucson	7,400	109%	134	118%
Yuma	1,894	228%	150	333%
<b>State Total</b>	<b>40,124</b>	<b>111%</b>	<b>827</b>	<b>123%</b>

Source: Cambridge Systematics, Inc., October 2003.

## ■ 5.6 Accessibility

Table 5.9 shows the percentage of state roadway miles estimated to be moderately and highly suitable for bicycling in 2002 and 2025. Increasing traffic volumes will cause the percentage of state roads estimated highly bike suitable to decrease from 23 percent to 14 percent, and the percentage estimated moderately suitable to decrease from 56 percent to 48 percent. Bike suitability is projected to decline the fastest in percentage terms in the Kingman and Tucson districts. In Kingman, the percentage of state roads highly suitable and moderately suitable for cycling will fall from 10 percent to five percent and from 71 percent to 45 percent, respectively. In the Globe, Phoenix, and Prescott districts, the



percentage of state roads moderately suitable will grow slightly as conditions worsen on roads currently estimated highly suitable.

**Table 5.9 Percent of State Road Miles Moderately/Highly Bike Suitable by District**

District	2002		2025	
	Percentage of State Road Miles Moderately Bike Suitable	Percentage of State Road Miles Highly Bike Suitable	Percentage of State Road Miles Moderately Bike Suitable	Percentage of State Road Miles Highly Bike Suitable
Flagstaff	59%	24%	48%	14%
Globe	50%	30%	52%	21%
Holbrook	63%	22%	49%	15%
Kingman	71%	10%	45%	5%
Phoenix	58%	19%	61%	12%
Prescott	49%	21%	50%	15%
Safford	56%	35%	56%	23%
Tucson	52%	9%	37%	4%
Yuma	49%	28%	41%	16%
<b>State Total</b>	<b>56%</b>	<b>23%</b>	<b>48%</b>	<b>14%</b>

Source: Cambridge Systematics, Inc., October 2003.

The Safford district has – and is projected to have in 2025 – the greatest percentage of bike suitable state roads. Combined, the percentage of roads estimated to be highly and moderately suitable was 91 percent in 2002 and will fall only slightly to 79 percent in 2025. The Tucson district has and is projected to have the lowest percentage of bike suitable state roads: 61 percent highly and moderately suitable in 2002, and 41 percent highly and moderately suitable in 2025.

## ■ 5.7 Resource Conservation

### Total Mobile Source Emissions

As shown in Table 5.10, vehicle emissions due to travel on the state roadway system in Arizona are projected to increase by 67 percent between 2002 and 2025. Mobile source

emissions in the Phoenix and Yuma districts are expected to grow the fastest over this period by 123 percent in Phoenix and 129 percent in Yuma. Arizona's remaining districts will also show increases in transportation-related emissions ranging from 10 to 65 percent, with Prescott showing the highest increase within the range.

**Table 5.10 Total Mobile Source Emissions by District (Metric Tons)**

<b>District</b>	<b>2002</b>	<b>2025</b>
Flagstaff	83	91
Globe	25	34
Holbrook	55	68
Kingman	60	73
Phoenix	251	560
Prescott	60	99
Safford	50	55
Tucson	131	181
Yuma	56	128
<b>State Total</b>	<b>771</b>	<b>1,288</b>

Note: This includes emissions from travel on the state road system.

Source: Cambridge Systematics, Inc., October 2003.

The Phoenix and Tucson districts account for about one-half of all mobile source emissions on the state transportation system in Arizona, both currently and in 2025. The Yuma district, while responsible for only a moderate amount of mobile source emissions compared to other districts (56 tons in 2002), is expected to have the third highest emissions of all Arizona districts in 2025 (128 tons) due to its high projected increase in VMT.

## Fuel Consumption

As shown in Table 5.11, fuel consumption due to travel on state roads is projected to increase by 176 percent between 2002 and 2025, from over four million gallons to about 12 million gallons of gasoline each day. Although VMT on the state highway system is projected to increase at only one-half this rate between 2002 and 2025, measures such as “percent PMT by LOS” and “average delay per trip” indicate that motor vehicle congestion and delay are increasing substantially, and average travel speed will decline. This causes vehicles to consume more fuel per mile traveled in 2025 than they did in 2002, on average.

**Table 5.11 Daily Fuel Consumption by District (Gallons)**

<b>District</b>	<b>2002</b>	<b>2025</b>	<b>Percent Change</b>
Flagstaff	436,235	846,999	94%
Globe	155,092	242,377	56%
Holbrook	276,347	617,528	123%
Kingman	309,992	767,568	148%
Phoenix	1,555,214	5,090,310	227%
Prescott	327,844	765,393	133%
Safford	259,819	555,306	114%
Tucson	695,671	1,697,151	144%
Yuma	288,042	1,305,129	353%
<b>State Total</b>	<b>4,304,257</b>	<b>11,887,762</b>	<b>176%</b>

Source: Cambridge Systematics, Inc., October 2003.

Fuel consumption is projected to double in most districts, and more than triple in the Yuma district. Only the Globe and Flagstaff districts will see fuel consumption increases of less than 100 percent.